NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

May 4, 2009

Flight Data Recorder - 10

Group Chairman's Factual Report
By R. Gregory Smith

1. EVENT SUMMARY

Location: Hudson River, New Jersey
Date: January 15, 2009
Aircraft: A320, Registration: N106US
Operator: US Airways, Flight 1549
NTSB Number: DCA09MA026

On January 15, 2009, about 1527 Eastern Standard Time, US Airways flight 1549, an Airbus A320-214, registration N106US, suffered bird ingestion into both engines, lost engine thrust, and landed in the Hudson River following take off from New York City's La Guardia Airport (LGA). The scheduled, domestic passenger flight, operated under the provisions of Title 14 CFR Part 121, was en route to Charlotte Douglas International Airport (CLT) in Charlotte, North Carolina.

2. FLIGHT DATA RECORDER GROUP

A flight data recorder (FDR) group was convened on 22 Jan 2009.

Chairman: R. Gregory Smith
                  Aerospace Engineer / FDR Specialist
                  National Transportation Safety Board

Member: Sam Farmiga
                  Manager & Principal Engineer, Engine Services Safety
                  GE Aviation

Member: Guillaume Gendrot
                  Recording/Monitoring Systems & Data Analysis
                  Airbus

Member: Julian Hall
                  EASA Representative, Washington DC
                  European Aviation Safety Agency

Member: Kenneth J. Lima
                  Sr. Avionics Engineer, Avionics Engineering
                  US Airways

Member: Dave Keenan
                  Air Safety Investigator

Federal Aviation Administration

Member: Bryan Mazey
                   CFM56-5A/B Model Engineer
                   GE Aviation

Member: Christopher McGregor
                   Director of Flight Safety, Accident Investigator
                   Airbus

Member: Thierry Thoreau
                   Director of Flight Safety, Accident Investigator
                   Airbus

3. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

On January 18, 2009, the Safety Board's Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model: **Honeywell SSFDR, Model 980-4700, 128 Word**
Recorder Serial Number: **7336**

The recorder arrived submerged in water but was otherwise in good condition. The recorder was removed from the water and disassembled, removing the memory board from the armored housing. The external connector for the memory board was wet but the memory inside the armor was dry. The connector was flushed with a drying agent to force the water from it. Once the drying agent had evaporated the connector and memory was attached to the Safety Board's bench unit and the data were extracted normally from the recorder memory.

3.1. Recorder Description

The Honeywell Solid State Flight Data Recorder (SSFDR) records airplane flight information in a digital format using solid-state flash memory as the recording medium. The SSFDR can receive data in the ARINC 573/717/747 configurations and can record a minimum of 25 hours of flight data. It is configured to record 128 12-bit words of digital information every second. Each grouping of 128 words (each second) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as either subframe 1, 2, 3, or 4. The sync word is the first word in each subframe. The data stream is "in sync" when successive sync words appear at proper 128-word intervals. Each data parameter (e.g. altitude, heading, airspeed) has a specifically assigned word number within the subframe. The SSFDR is designed to meet the crash-survivability requirements of TSO–C124.

3.2. FDR Carriage Requirements

Federal regulations regarding the carriage requirements of FDRs on aircraft can be found in the following regulations: 14 CFR 121.343, 14 CFR 121.344, 14 CFR 121.344a and 14 CFR 135.152. In general, for turbine-powered transport category aircraft manufactured on or before October 11, 1991, an FDR must be installed on board that records a minimum of 18 parameters, and for those turbine-powered aircraft that seat between 10 and 19 passengers, the minimum is 22 parameters. Newly manufactured aircraft are required to

be equipped with an FDR that records a minimum of 88 parameters. Specifically, the accident aircraft, N106US, was operating such that it was required to be equipped with an FDR that recorded 34 parameters, as cited in 14 CFR 121.344. The accident aircraft was in compliance with the federal FDR carriage requirements.

3.3.   Recording Description

The FDR recording contained approximately 18.2 hours of data.[1] Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The accident flight was the last flight of the recording and its duration was approximately 5 minutes and 49 seconds from application of take-off thrust to the end of recording.

3.3.1. Recording Discontinuities

The FDR recording contained three timing discontinuities for the accident recording sequence, which begins at engine start. The first of these occurred after engine 2 spooled up enough to drive generator 2 to power AC bus 2, which powers the Flight Data Interface Unit (FDIU). The other two occurrences were during the accident flight at approximately 15:27:19 and 15:28:30. All three discontinuities were short enough to not reset the FDIU's internal frame counter as occurs when there is a significant power interruption to the FDIU. The discontinuities appeared as additional bits being inserted into the data stream that was recovered from the FDR. These additional bits were removed and all of the recorded data was recovered.

3.4.   Time Correlation

Correlation of the FDR data from SRN to the accident local time, Eastern Standard Time (EST), was established with an offset provided by the Aircraft Performance Specialist in the Aircraft Performance Study. Accordingly, the time offset for the accident flight data from SRN to local EST is the following: EST = SRN – 9701.119. Therefore, for the rest of this report, all times are referenced as EST, not SRN.

3.5.   Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the operator and aircraft manufacturer. Where applicable, the conversions have been changed to ensure that the parameters conform to the Safety Board's standard sign convention that climbing right turns are positive (CRT=+).[2]

3.5.1. Parameters Provided and Verified

The following table lists the FDR parameters provided and verified in this report.

Table 1 – Verified Parameters

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[1] The recorder was capable of recording the required 25 hours of data but had recently been replaced. The airline retained the previous recording and made a copy of the data available to the Safety Board but it was not reviewed during the course of the investigation.

[2] CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +.

Parameter Name	Plot Label	Units
A/C Tail Number Character 1	AC TN Char 1	
A/C Tail Number Character 2	AC TN Char 2	
A/C Tail Number Character 3	AC TN Char 3	
A/C Tail Number Character 4	AC TN Char 4	
A/C Tail Number Character 5	AC TN Char 5	
A/C Tail Number Character 6	AC TN Char 6	
A/C Tail Number Character 7	AC TN Char 7	
A/C Type	AC Type	
AC 1 bus ON	ACBus-1	
AC 2 bus ON	ACBus-2	
AC ess bus ON	ACBus-Ess	
Lateral Acceleration	Accel Lat	g
Longitudinal Acceleration	Accel Long	g
Normal Acceleration	Accel Vert	g
Left Aileron Position	Aileron-L	deg
LH Ail Blue Avail	Aileron-L Blue	
LH Ail Green Avail	Aileron-L Green	
Right Aileron Position	Aileron-R	deg
RH Ail Blue Avail	Aileron-R Blue	
RH Ail Green Avail	Aileron-R Green	
Indicated Airspeed	Airspeed Ind	kts
Altitude Standard Pressure	Altitude Press	ft
Radio Altitude 1	Altitude Radio 1	ft
Radio Altitude 2	Altitude Radio 2	ft
Eng 1 Anti-Ice P/B On	Anti-Ice PB Eng1	
Eng 2 Anti-Ice P/B On	Anti-Ice PB Eng2	
Eng 1 Anti-Ice Valve Not Fault	Anti-Ice Valve Eng1	
Eng 2 Anti-Ice Valve Not Fault	Anti-Ice Valve Eng2	
Wing Anti-Ice Valve LH Not Closed	Anti-Ice Vlv Wing-L	
Wing Anti-Ice Valve RH Not Closed	Anti-Ice Vlv Wing-R	
Wing Anti-Ice P/B Off	Anti-Ice Wing PB	
Angle of Attack LH	AOA-L	deg
Angle of Attack RH	AOA-R	deg
A/P Off Warning	AP Off Warning	
A/P 1 Engaged	AP-1 Status	
A/P 2 Engaged	AP-2 Status	
APU Bleed Valve	APU Bld Vlv	
APU Fire	APU Fire	
Cabin Pressure Warning	Cabin Press Warn	
DC 1 Bus ON	DCBus-1	
DC 2 Bus ON	DCBus-2	
DC Ess Bus ON	DCBuss-Ess	
Drift Angle	Drift Angle	deg
ECAM Pages (Matrix 9)	ECAM Page Sel	
ECU/EEC 1 Channel B in CTL	ECU1 Channel	
EEC 1 No Data	ECU1 Fault	
ECU/EEC 2 Channel B in CTL	ECU2 Channel	
EEC 2 No Data	ECU2 Fault	

Parameter Name	Plot Label	Units
Left & Right Elevator Fault	Elevator Fault-L+R	
Left Elevator Position	Elevator-L	deg
Right Elevator Position	Elevator-R	deg
Engine 1 EGT	Eng1 EGT	degC
Engine 1 FADEC Fault	Eng1 FADEC	
Engine 1 Fire	Eng1 Fire	
Engine 1 Fuel Fire Valve Not Fully Closed	Eng1 Fuel Fire Valve	
Engine 1 Fuel Flow	Eng1 Fuel Flow	pph
Engine 1 HP Fuel Valve	Eng1 HP Fuel Valve	
Engine 1 HPV Not Fully Closed	Eng1 HPV	
Engine 1 Identification	Eng1 Ident	
Engine 1 N1 Actual	Eng1 N1 Act	%RPM
Engine 1 N1 Command	Eng1 N1 Cmd	%RPM
Engine 1 N1 Vibration	Eng1 N1 Vib	
Engine 1 N1/EPR Mode Selection	Eng1 N1-EPR Mode	
Engine 1 N2 Actual	Eng1 N2	%RPM
Engine 1 N2 Vibration	Eng1 N2 Vib	
Engine 1 Oil Low Press	Eng1 Oil Press	
Engine 1 Oil Quantity	Eng1 Oil Qty	qt
Engine 1 OPV Not Fully Opened	Eng1 OPV	
Engine 1 PRV Not Fully Closed	Eng1 PRV	
Engine 1 Severity Ice Detected	Eng1 Sev Ice Det	
Engine 1 Starter Valve Not Closed	Eng1 Start Vlv	
Engine 1 Throttle Lever Angle	Eng1 TLA	deg
Engine 1 Thrust Reverser Deployed	Eng1 TR Deploy	
Engine 1 Thrust Reverser Unlock	Eng1 TR Lock	
Engine 1 Cross Feed Valve Not Fully Closed	Eng1 X Feed Vlv	
Engine 2 EGT	Eng2 EGT	degC
Engine 2 FADEC Fault	Eng2 FADEC	
Engine 2 Fire	Eng2 Fire	
Engine 2 Fuel Fire Valve Not Fully Closed	Eng2 Fuel Fire Valve	
Engine 2 Fuel Flow	Eng2 Fuel Flow	pph
Engine 2 HP Fuel Valve	Eng2 HP Fuel Valve	
Engine 2 HPV Not Fully Closed	Eng2 HPV	
Engine 2 Identification	Eng2 Ident	
Engine 2 N1 Actual	Eng2 N1 Act	%RPM
Engine 2 N1 Command	Eng2 N1 Cmd	%RPM
Engine 2 N1 Vibration	Eng2 N1 Vib	
Engine 2 N1/EPR Mode Selection	Eng2 N1-EPR Mode	
Engine 2 N2 Actual	Eng2 N2	%RPM
Engine 2 N2 Vibration	Eng2 N2 Vib	
Engine 2 Oil Press Low	Eng2 Oil Press	
Engine 2 Oil Quantity	Eng2 Oil Qty	qt
Engine 2 OPV Not Fully Opened	Eng2 OPV	
Engine 2 PRV Not Fully Closed	Eng2 PRV	
Engine 2 Severity Ice Detected	Eng2 Sev Ice Det	
Engine 2 Starter Valve Not Closed	Eng2 Start Vlv	
Engine 2 Throttle Lever Angle	Eng2 TLA	deg

Parameter Name	Plot Label	Units
Engine 2 Thrust Reverser Deployed	Eng2 TR Deploy	
Engine 2 Thrust Reverser Unlock	Eng2 TR Lock	
Event Marker	Event	
Flap Lever Position	Flap Lever Pos	
Flaps Position	Flap Pos	deg
Flaps Fault	Flaps Fault	
Flight Number	Flight Num	
Frame Counter	Frame Counter	cnts
Gear Down Locked	Gear Down Locked	
Gear Selection Down	Gear Select Down	
Gear Selection Up	Gear Select Up	
Gear Up Locked	Gear Up Locked	
Left Landing Gear Squat Switch	Gear WOW-L	
Nose Landing Gear Squat Switch	Gear WOW-N	
Right Landing Gear Squat Switch	Gear WOW-R	
Gross Weight	Gross Weight	lb
Ground Speed	Ground Speed	kts
Heading	Heading	deg
True/Magnetic Heading Selected	Heading Tr-Mg	
Low Hydraulic Pressure Blue	Hyd Press-Blue	
Low Hydraulic Pressure Green	Hyd Press-Green	
Low Hydraulic Pressure Yellow	Hyd Press-Yellow	
VHF Keying	Key VHF	
Present Position Latitude	Latitude	deg
Present Position Longitude	Longitude	deg
Master Warning	Master Warning	
N1 Target	N1 Target	%RPM
Pack 1 Flow Control Valve Not Fully Closed	Pack1 Flow Ctrl Vlv	
Pack 2 Flow Control Valve Not Fully Closed	Pack2 Flow Ctrl Vlv	
Pitch Attitude	Pitch	deg
Warning PITCH Discrepancy	Pitch Discrep Warn	
Pitch Alt 1 Law	Pitch Law Alt 1	
Pitch Alt 2 Law	Pitch Law Alt 2	
Pitch Direct Law	Pitch Law Direct	
Normal Pitch Law	Pitch Law Normal	
Red Warning	Red Warning	
Roll Attitude	Roll	deg
Warning ROLL Discrepancy	Roll Discrep Warn	
Rudder Position	Rudder	deg
Rudder Pedal Position	Rudder Ped Pos	deg
Rudder Trim Position	Rudder Trim Pos	deg
Slats Position	Slat Pos	deg
Slats Fault	Slats Fault	
Avionics Smoke Warning	Smoke Avionic Warn	
Cargo Smoke Warning	Smoke Cargo Warn	
Lavatory Smoke Warning	Smoke Lavatory Warn	
Speed Brake Command	Spd Brake Cmnd	
Spoiler 1 Validity	Spoiler 1 Status	

Parameter Name	Plot Label	Units
Spoiler 2 Validity	Spoiler 2 Status	
Spoiler 3 Validity	Spoiler 3 Status	
Spoiler 4 Validity	Spoiler 4 Status	
Spoiler 5 Validity	Spoiler 5 Status	
Ground Spoiler Armed	Spoiler Grnd Armed	
Left Spoiler 1 Out	Spoiler-L1 Pos	
Left Spoiler 2 Position	Spoiler-L2 Pos	deg
Left Spoiler 3 Position	Spoiler-L3 Pos	deg
Left Spoiler 4 Position	Spoiler-L4 Pos	deg
Left Spoiler 5 Position	Spoiler-L5 Pos	deg
Right Spoiler 1 Out	Spoiler-R1 Pos	
Right Spoiler 2 Position	Spoiler-R2 Pos	deg
Right Spoiler 3 Position	Spoiler-R3 Pos	deg
Right Spoiler 4 Position	Spoiler-R4 Pos	deg
Right Spoiler 5 Position	Spoiler-R5 Pos	deg
Stabilizer Position	Stabilizer Pos	deg
Stall Warning	Stall Warning	
Left Sidestick Fault	Stick Fault-L	
Right Sidestick Fault	Stick Fault-R	
Left Sidestick Inoperative	Stick Inop-L	
Right Sidestick Inoperative	Stick Inop-R	
Left Roll Command Position	Stick Lat-L	deg
Right Roll Command Position	Stick Lat-R	deg
Left Pitch Command Position	Stick Long-L	deg
Right Pitch Command Position	Stick Long-R	deg
UTC Hours	Time GMT Hrs	hrs
UTC Minutes	Time GMT Min	min
UTC Seconds	Time GMT Sec	sec
True Air Temperature (TAT)	Total Air Temp	degC
Wind Direction True	Wind Direction	deg
Wind Speed	Wind Speed	kts
Yaw Damper 1 Fault	Yaw Damp 1 Fault	
Yaw Damper 2 Fault	Yaw Damp 2 Fault	

3.5.2. Pressure Altitude

This FDR records standard pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the FDR plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

3.6.   FDR Plots and Corresponding Tabular Data

The following 12 plots contain FDR data recorded during the January 15, 2009 accident flight. These plots are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes

towards the top of the page. The times that the two discontinuities in the recording of the flight occurred are annotated on the plots with black vertical lines.

Plot 1 is a general overview of the accident flight and contains the parameters: Vertical, Longitudinal, and Lateral Accelerations; Roll Attitude; Pitch Attitude; FDR Frame Counter; Heading and True/Magnetic Heading (the discrete that indicates whether the recorded heading is magnetic heading or true heading); Engine 1 and 2 Commanded and Actual N1; (the discrete parameters indicating whether the engines are being operated based on N1 or EPR settings); Pressure Altitude; and Indicated Airspeed. The fluctuations in Indicated Airspeed prior to takeoff indicate that the FDIU is not receiving valid airspeed at that time.

Plot 2 is an overview of the analog parameters for both engines for the accident flight and contains following parameters for Engines 1 and 2: Oil Quantity; Fuel Flow; N2 Vibration; N1 Vibration; EGT; Throttle Lever Angle; N1 Commanded; N1 Target (only one parameter for both engines); N1 Actual; N2; Pressure Altitude; and Indicated Airspeed.

Plot 3 is an overview of the discrete parameters for both engines for the accident flight and contains the following parameters for Engines 1 and 2: Thrust Reversers Deployed and Unlocked; Cross Feed Valve Closed (only one parameter for both engines); Start Valve Closed; Severity Ice Detected; Pressure Regulating Valve (PRV) Closed; Overpressure Valve (OPV) Open; Oil Pressure Low; N1-EPR Mode; High Pressure Valve (HPV) Closed; High Pressure (HP) Fuel Valve Closed; Fuel Fire Valve Closed; Fire Warning; FADEC Fault; Pressure Altitude; and Indicated Airspeed.

Plot 4 is an overview of the parameters for Engine 1 for the accident flight and contains the following parameters: Cross Feed Valve Closed; Start Valve Closed; Severity Ice Detected; Pressure Regulating Valve (PRV) Closed; Overpressure Valve (OPV) Open; Oil Pressure Low; N1-EPR Mode; High Pressure Valve (HPV) Closed; High Pressure (HP) Fuel Valve Closed; Fuel Fire Valve Closed; Fire Warning; FADEC Fault; Oil Quantity; Fuel Flow; N2 Vibration; N1 Vibration; EGT; Throttle Lever Angle; N1 Commanded; N1 Actual; N2; Pressure Altitude; and Indicated Airspeed.

Plot 5 is an overview of the parameters for Engine 2 for the accident flight and contains the following parameters: Start Valve Closed; Severity Ice Detected; Pressure Regulating Valve (PRV) Closed; Overpressure Valve (OPV) Open; Oil Pressure Low; N1-EPR Mode; High Pressure Valve (HPV) Closed; High Pressure (HP) Fuel Valve Closed; Fuel Fire Valve Closed; Fire Warning; FADEC Fault; Oil Quantity; Fuel Flow; N2 Vibration; N1 Vibration; EGT; Throttle Lever Angle; N1 Commanded; N1 Actual; N2; Pressure Altitude; and Indicated Airspeed.

Plot 6 is an overview of the pitch axis parameters for the accident flight and contains the following parameters: Left and Right Longitudinal Stick Positions; Stabilizer Position; Normal, Direct, Alternate 1, and Alternate 2 Pitch Laws (discrete parameters indicating which pitch law mode the flight controls were operating in); Pitch Discrepancy Warning; Pitch Attitude; Left an Right Elevator Positions; Left and Right Elevator Fault (only one parameter for both faults); Left and Right Angle of Attack; Radio Altitudes 1 and 2; Pressure Altitude; and Indicated Airspeed.

Plot 7 is an overview of the Flaps, Slats, and Spoiler parameters for the accident flight and contains the following parameters: Slat Position; Slats Fault; Left and Right Spoiler 1 through 5 Positions; Ground Spoiler Armed; Spoiler 1 through 5 Status; Speed Brake Commanded; Flaps Fault; Flap Position; Flap Lever Position; Pitch Attitude; Radio Altitudes 1 and 2; Pressure Altitude; and Indicated Airspeed.

Plot 8 is an overview of the roll axis parameters for the accident flight and contains the following parameters: VHF Radio Key; Master Warning; Red Warning; Stall Warning; Low Hydraulic Pressure Yellow, Green, and Blue; Right and Left Aileron, Green and Blue Hydraulic System, Available; Left and Right Aileron Positions; Left and Right Side Stick Inop; Left and Right Side Stick Fault; Left and Right Lateral Stick Position; Roll Discrepancy Warning; Roll Attitude; Radio Altitude 1 and 2; Pressure Altitude; and Indicated Airspeed.

Plot 9 is an overview of the yaw axis, wind, and smoke parameters for the accident flight and contains the following parameters: Cabin Pressure Warning; Lavatory, Cargo, and Avionics Smoke Warnings; Total Air Temperature; Wind Speed and Direction; Yaw Damper 1 and 2 Faults; Rudder Trim Position; Rudder Pedal Position; Rudder Position; Magnetic Heading; Radio Altitude 1 and 2; Pressure Altitude; Ground Speed; and Indicated Airspeed.

Plot 10 is an overview of miscellaneous parameters for the accident flight and contains the following parameters: AC Busses 1, 2 and Essential Status; Auto Pilot 1 and 2 Status; Auto Pilot Off Warning; APU Bleed Valve Open; APU Fire Warning; DC Busses 1, 2 and Essential Status; Packs 1 and 2 Flow Control Valve Closed; Gross Weight; Latitude; Longitude; Radio Altitude 1 and 2; Pressure Altitude; and Indicated Airspeed.

Plot 11 is an overview of miscellaneous parameters for the accident flight and contains the following parameters: ECAM Page Selected; Radio Altitude 1; Engines 1 and 2 N2; ECU 1 and 2 Faults and Channel In Control; Drift Angle; Wing and Engines 1 and 2 Anti-Ice Push Buttons; and Left and Right Wing and Engines 1 and 2 Anti-Ice Valves.

Plot 12 is an overview of the parameters for Engine 2 for the accident flight and contains the following parameters: Engines 1 and 2 N1, N2, N1 Vibrations and N2 Vibrations; and Radio Altitude 1.
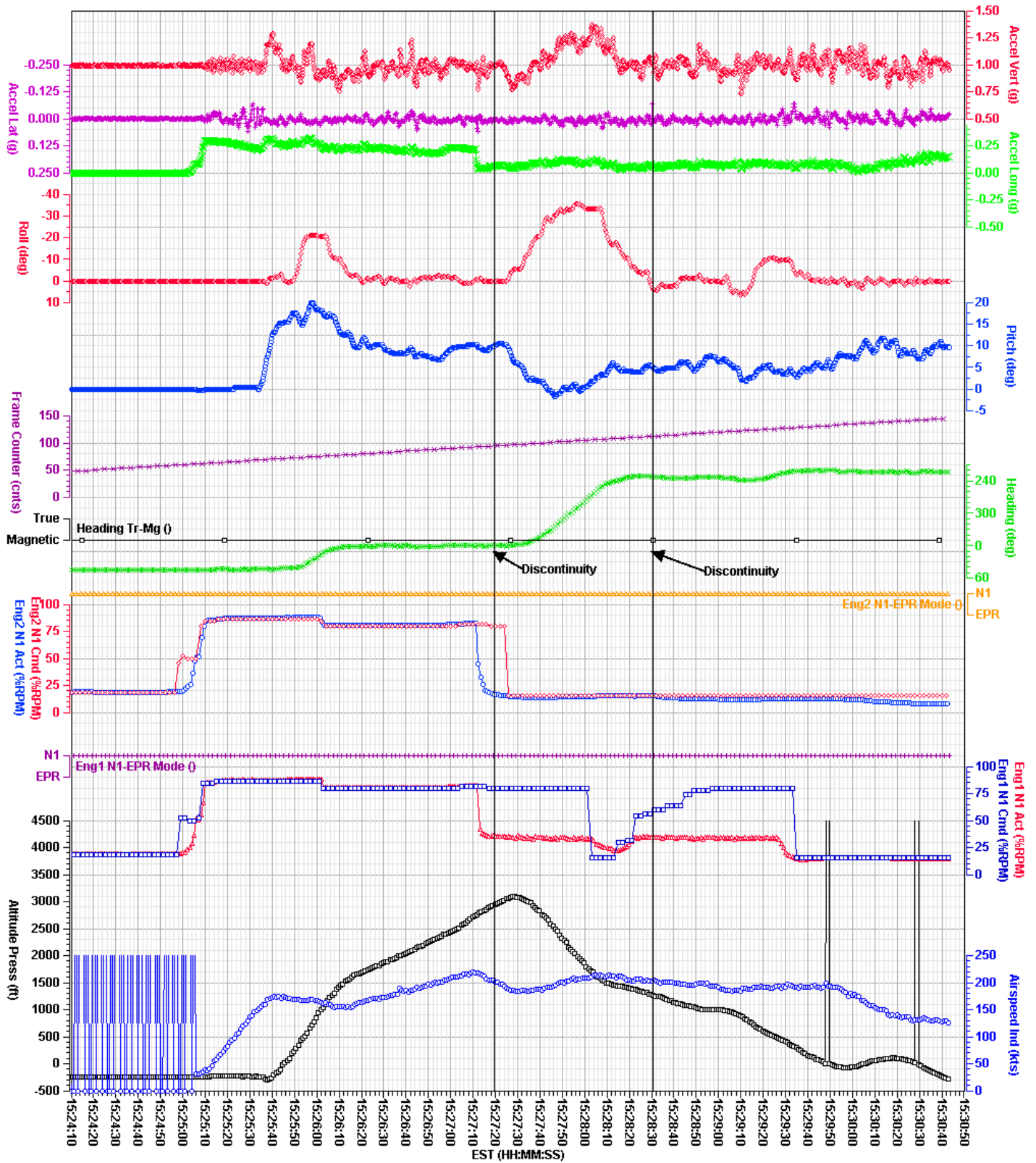
Attachment 1 to this report contains the tabular data for all parameters listed in Table 1 in electronic format (a zipped, comma separated value file) for the accident recording sequence. Not all data contained in Attachment 1 is contained in the following plots.

Plot 1
US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09

NTSB No. DCA09MA026

Discontinuity

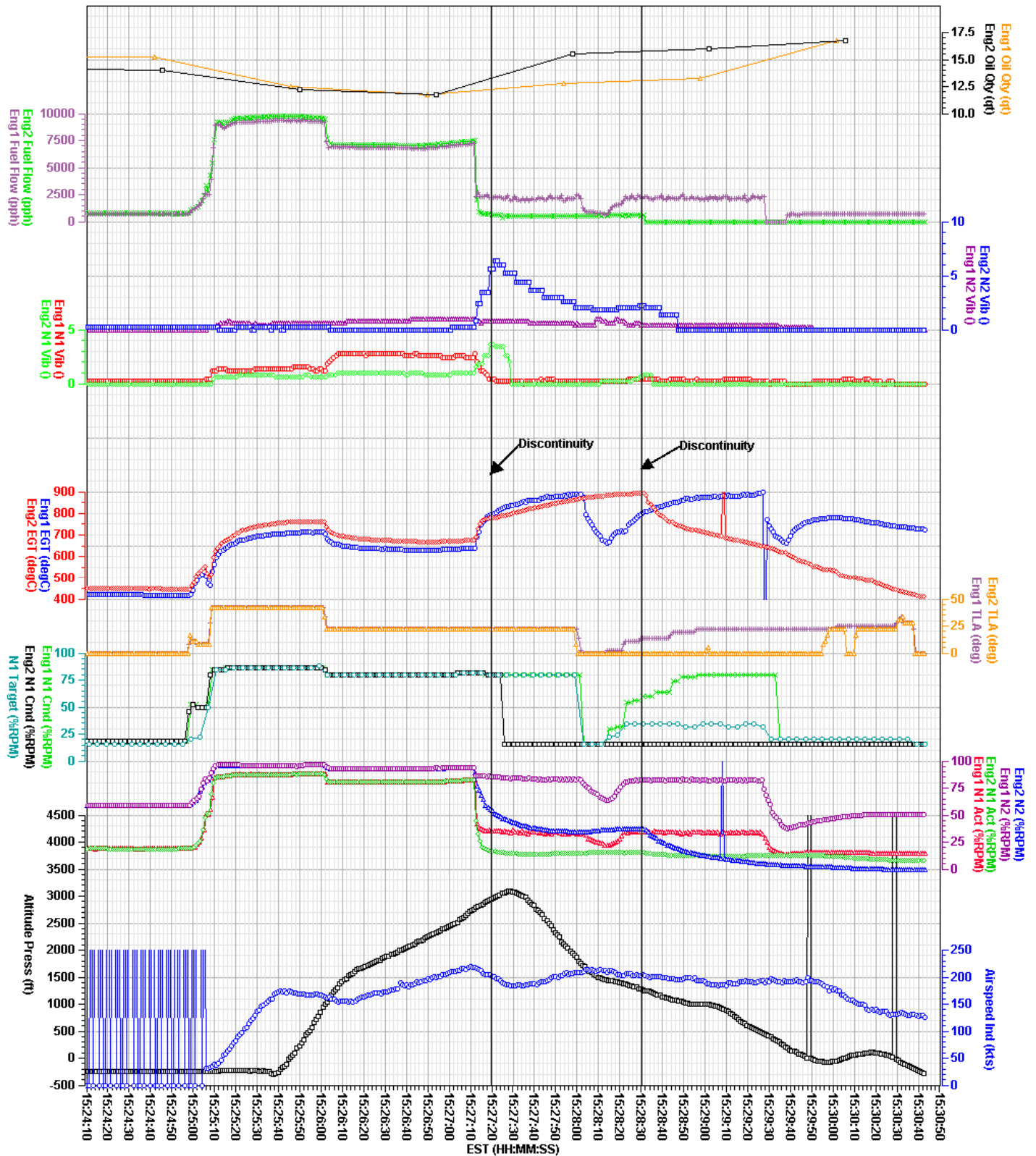Discontinuity

Plot 2

US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09

NTSB No. DCA09MA026

EST (HH:MM:SS)

Plot 3
US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09
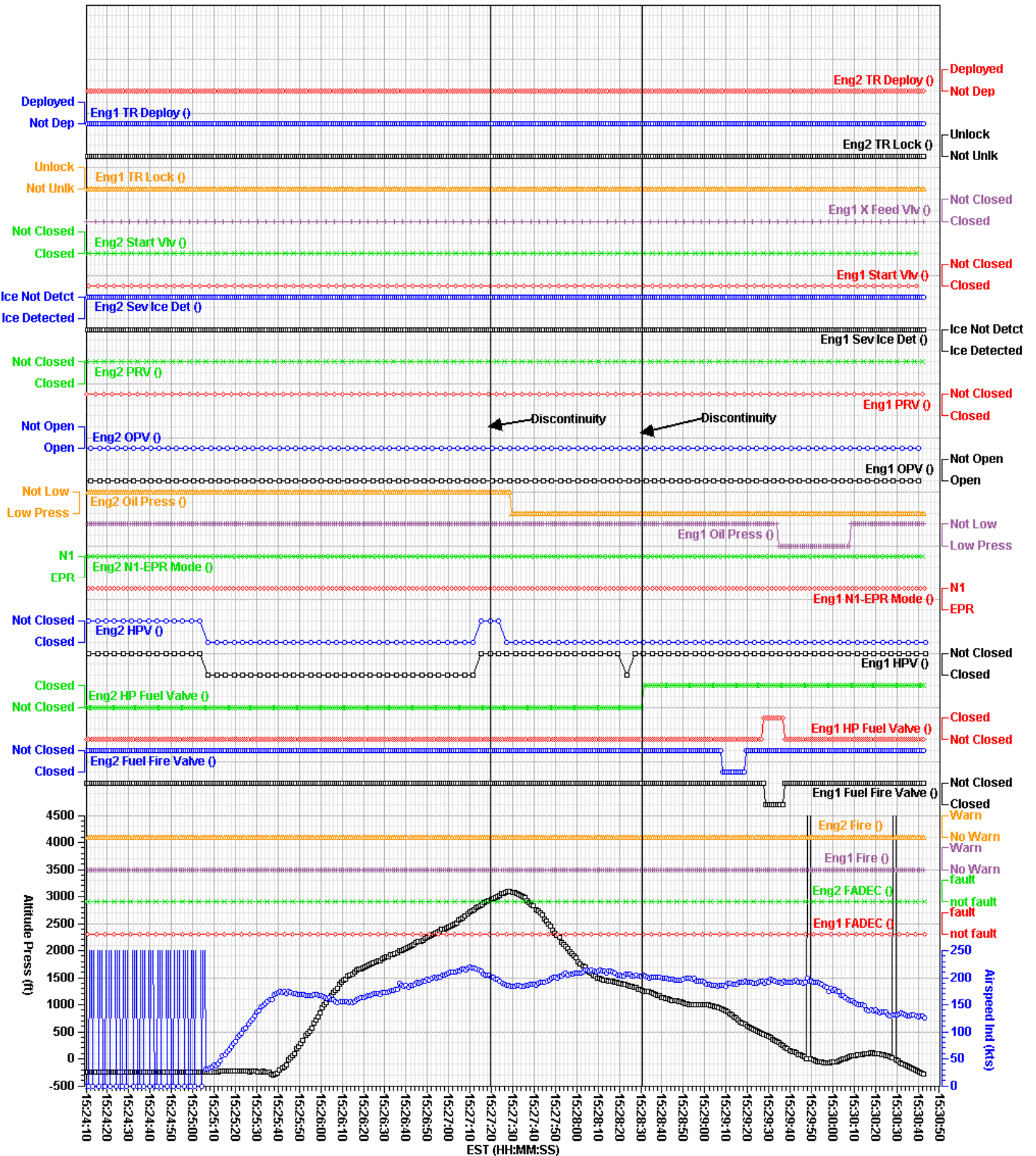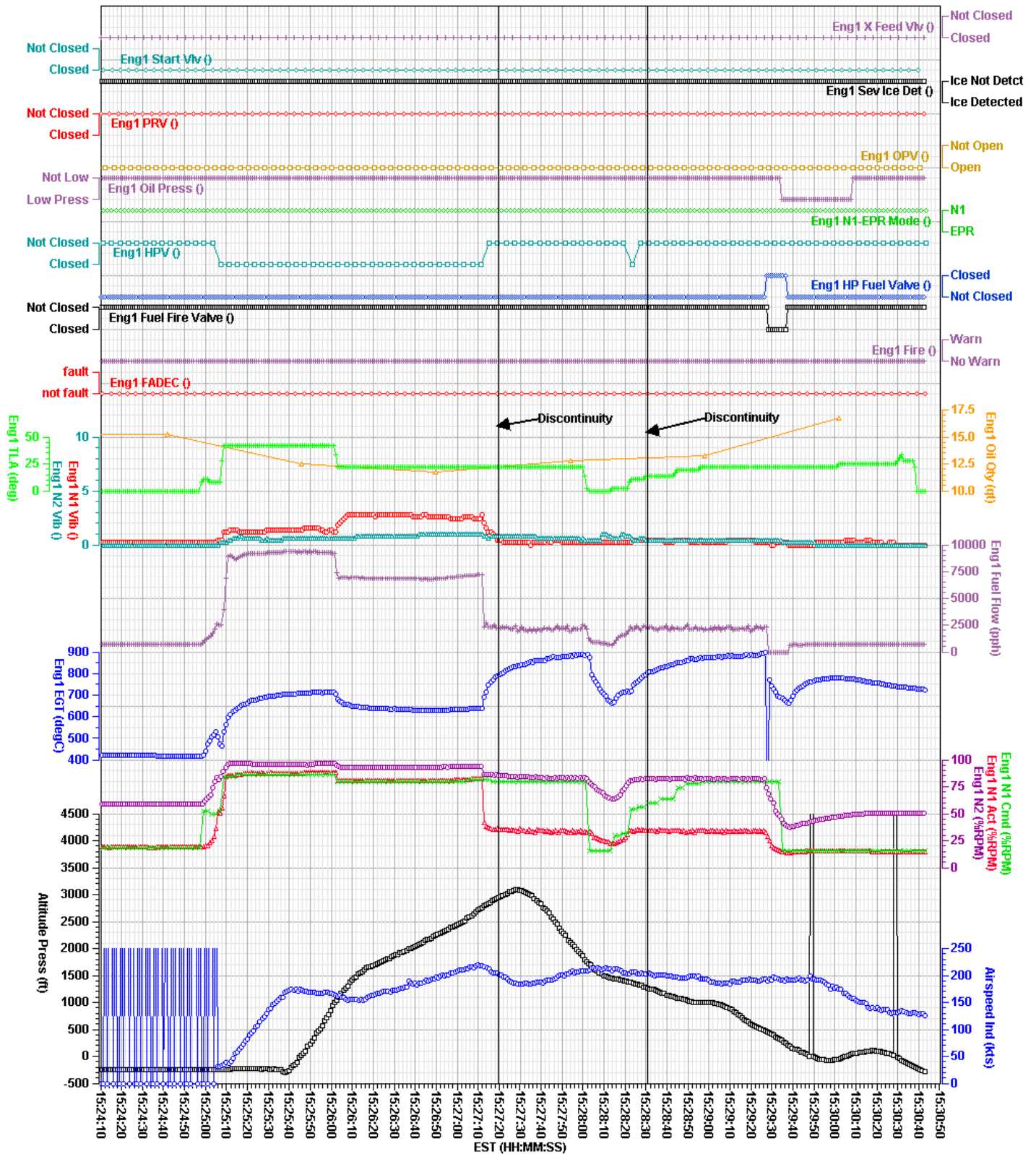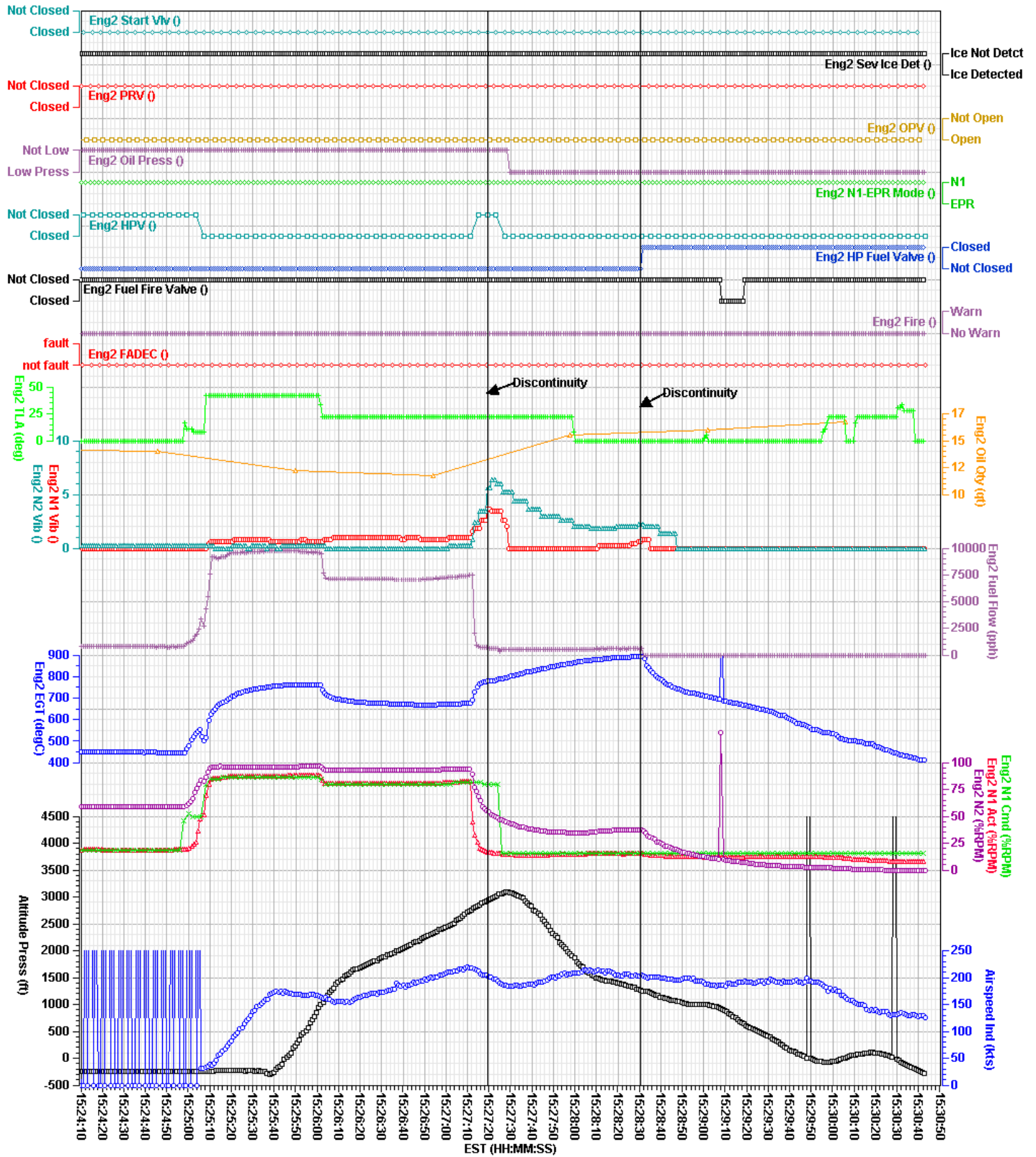
NTSB No. DCA09MA026

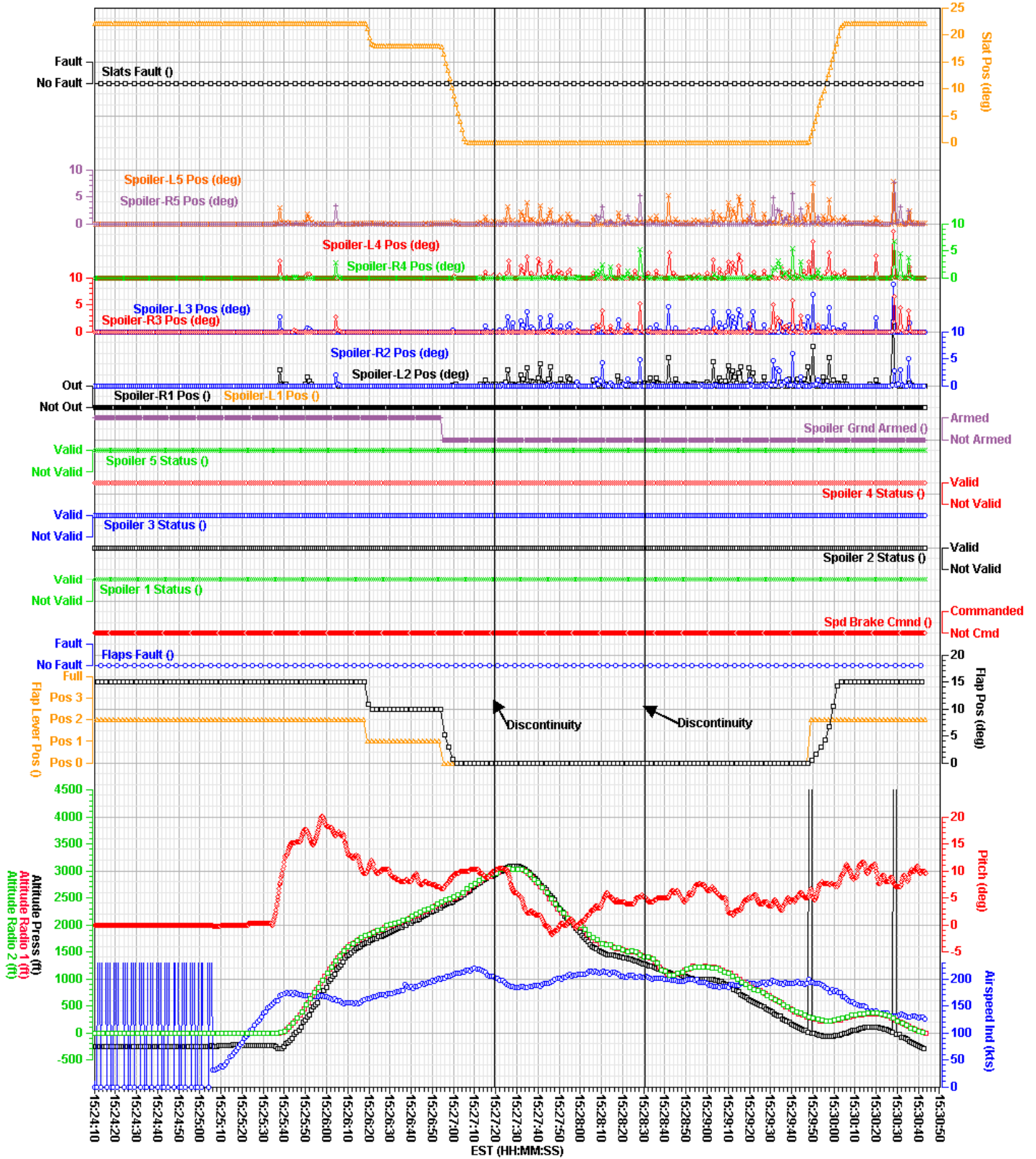Plot 3 - Engine Discretes
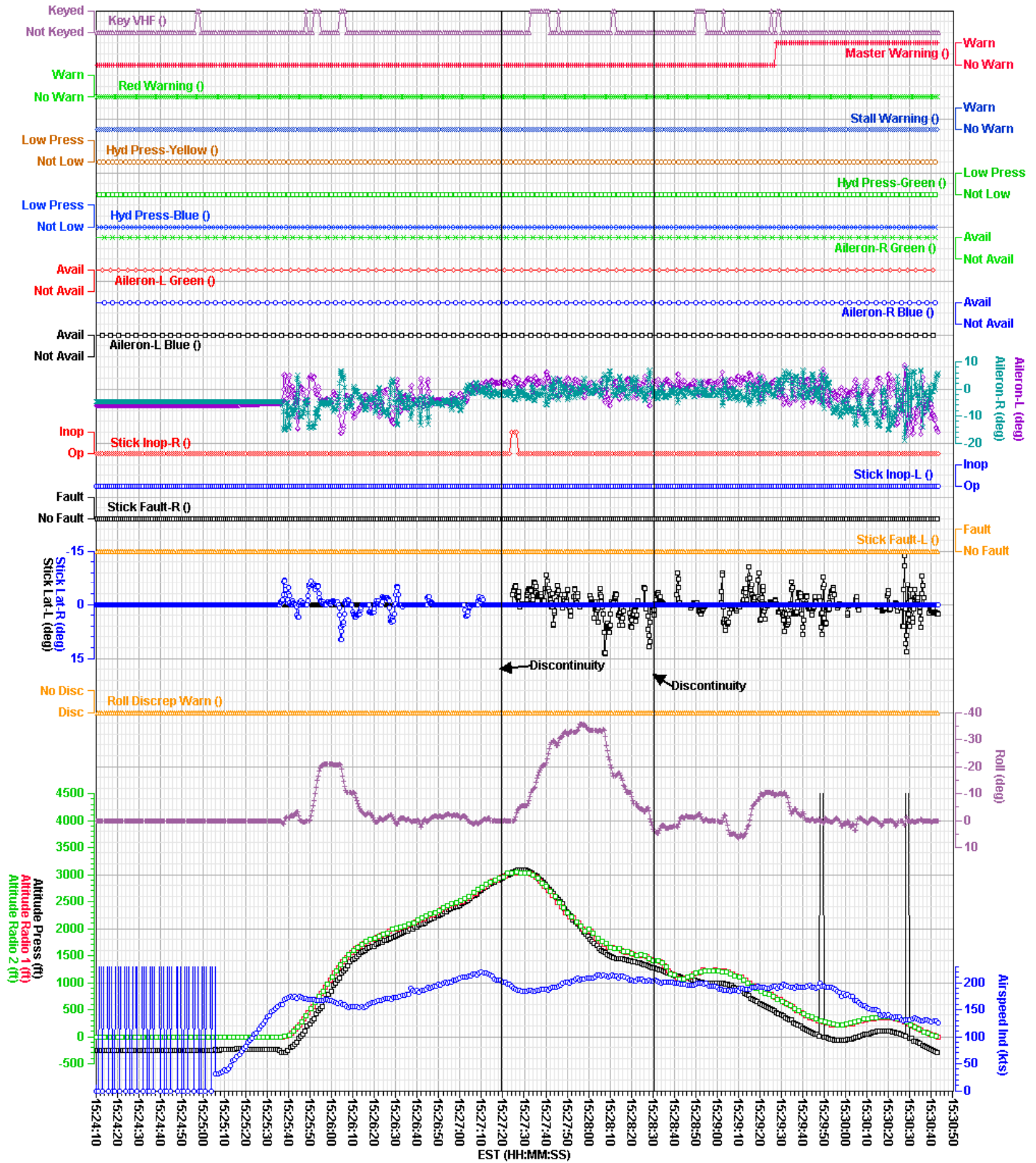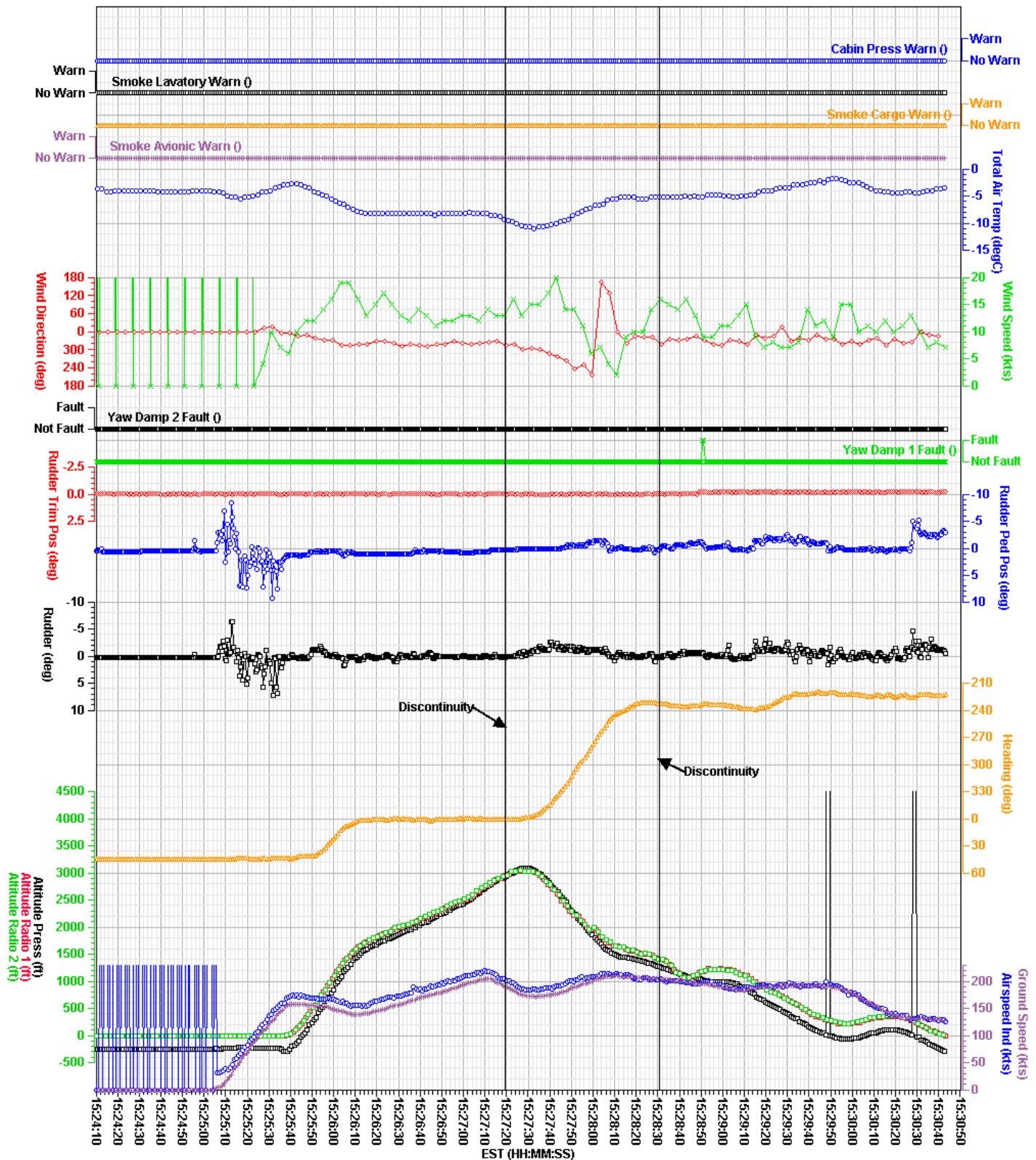
Revised: 8 April 2009

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Plot 4

US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09

NTSB No. DCA09MA026

Eng1 X Feed Vlv () — Not Closed / Closed
Eng1 Start Vlv () — Not Closed / Closed
Eng1 Sev Ice Det () — Ice Not Detct / Ice Detected
Eng1 PRV () — Not Closed / Closed
Eng1 OPV () — Not Open / Open
Eng1 Oil Press () — Not Low / Low Press
Eng1 N1-EPR Mode () — N1 / EPR
Eng1 HPV () — Not Closed / Closed
Eng1 HP Fuel Valve () — Closed / Not Closed
Eng1 Fuel Fire Valve () — Not Closed / Closed
Eng1 Fire () — Warn / No Warn
Eng1 FADEC () — fault / not fault

Discontinuity   Discontinuity

Eng1 TLA (deg)
Eng1 N1 Vib () / Eng1 N2 Vib ()
Eng1 Oil Qty (qt)
Eng1 Fuel Flow (pph)
Eng1 EGT (degC)
Eng1 N1 Cmd (%RPM) / Eng1 N1 Act (%RPM) / Eng1 N2 (%RPM)
Altitude Press (ft)
Airspeed Ind (kts)

EST (HH:MM:SS)

Plot 5
US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09

NTSB No. DCA09MA026

Plot 6
US Airways, Airbus A320, Flt 1549, N106US

Location, Date: New York City, NY, 01/15/09

EST (HH:MM:SS)

Plot 7
US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09

Revised: 8 April 2009
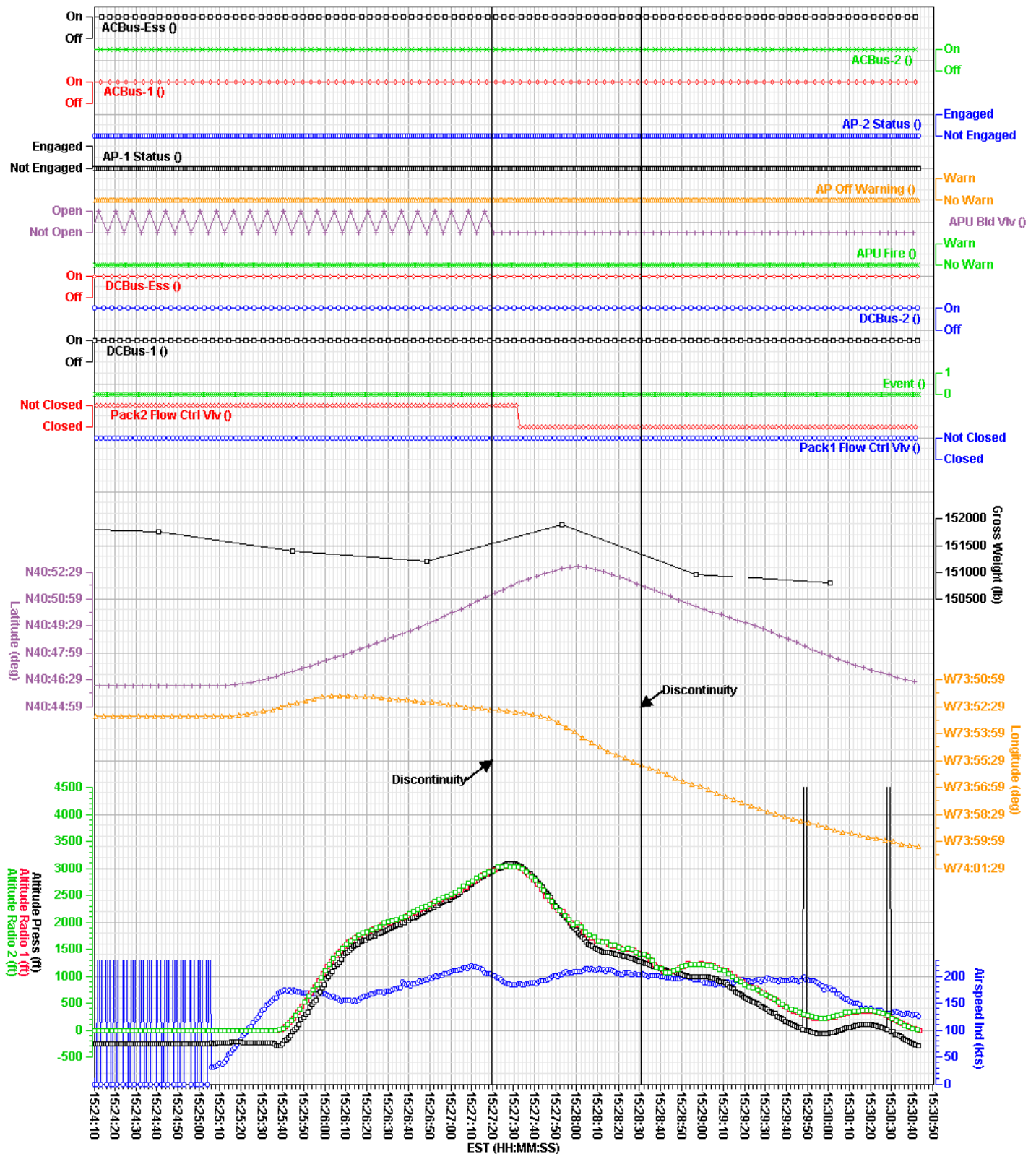
Plot 7 - Flaps, Slats, and Spoilers

National Transportation Safety Board

Plot 8
US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09

NTSB No. DCA09MA026

Plot 9
US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09

NTSB No. DCA09MA026

Plot 9 - Yaw, Wind and Smoke Parameters

National Transportation Safety Board

Plot 10
US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09

NTSB No. DCA09MA026
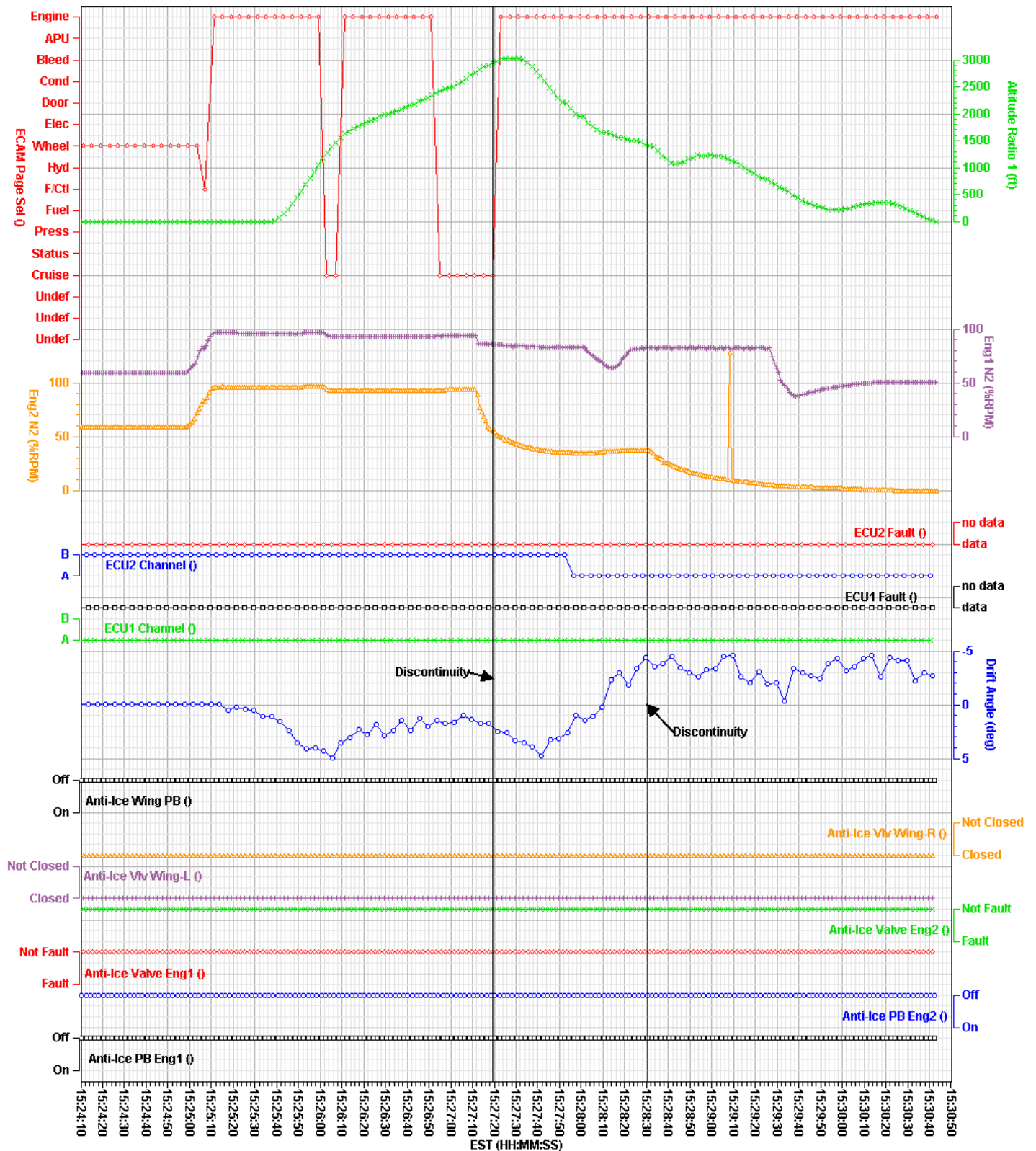
Revised: 8 April 2009

Plot 10 - Misc Parameters 1
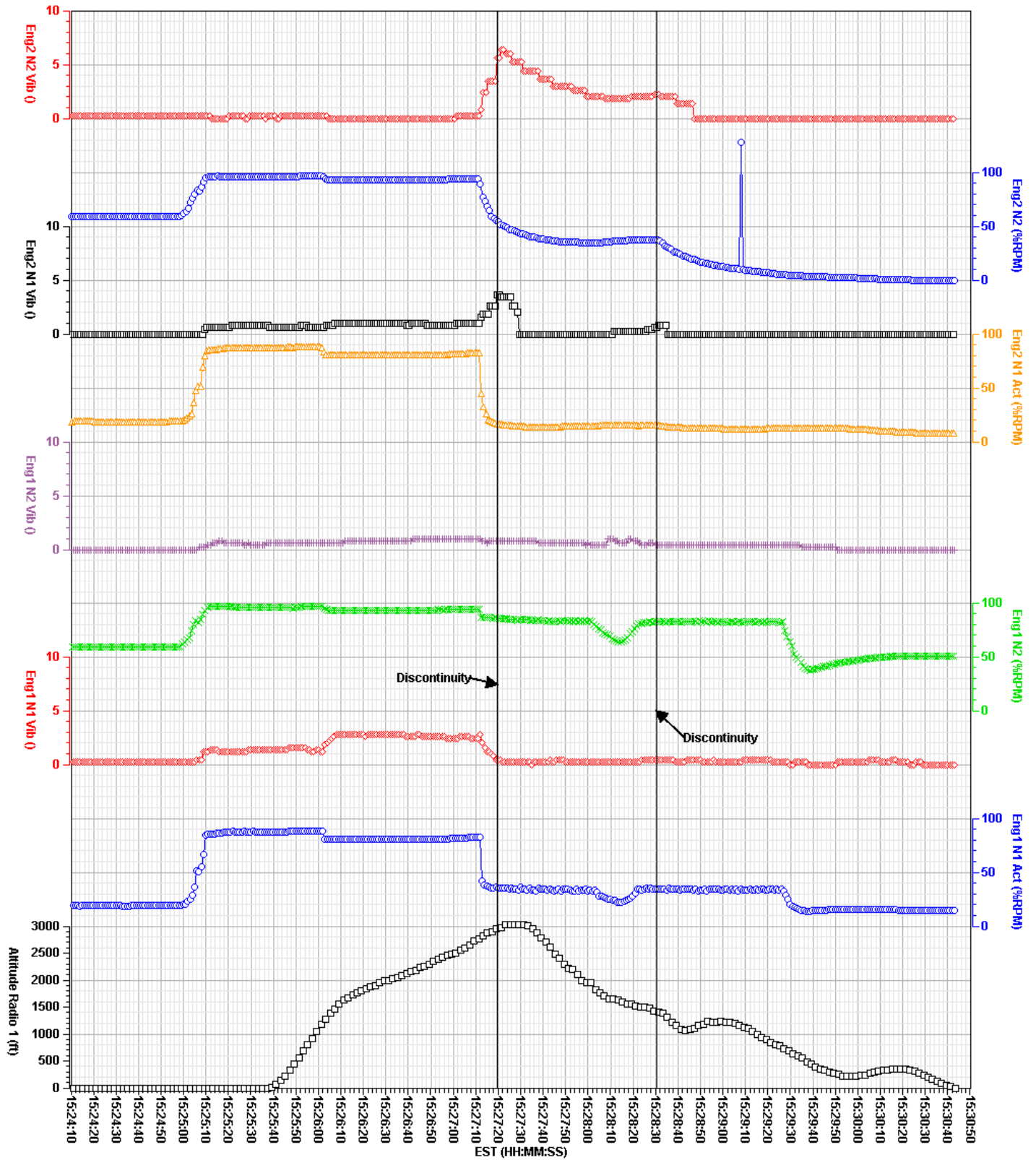
National Transportation Safety Board

Plot 11
US Airways, Airbus A320, Flt 1549, N106US

Plot 11 - Misc Parameters 2

Plot 12
US Airways, Airbus A320, Flt 1549, N106US

Location, Date: Hudson River, NJ, 01/15/09

Discontinuity

Discontinuity

EST (HH:MM:SS)

Plot 12 - Engine Vibrations